A STUDY OF [illegible] OF TEACHING AND PLANS FOR [illegible] RESULTS IN FARM MECHANICS AND FARM CARPENTRY TOGETHER WITH RELATED SCIENCE

by

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PURPOSE OF THIS STUDY

Having taught vocational agriculture several years and having found the approach to the farm shop problems rather indefinite, the writer especially became interested in Farm Woodwork and Farm Carpentry with the thought in mind of determining as far as possible any fixed procedure which seemed to have grown out of the experience of teachers of vocational agriculture facing similar problems.

Many of the problems found in teaching vocational agriculture farm shop work have been solved by the trial and error method. The results of such teaching should provide a considerable fund of information to teachers of this work

providing they are properly summarized and put together. The purpose of this study is to obtain and summarize specific information along three lines in connection with the Farm Woodwork and Farm Carpentry taught in vocational agriculture farm shop work in Kansas high schools. These three lines are, first, Methods of Teaching; second, Plans for Checking; and third, Related Information which should be taught in connection with the farm shop work.

PROCEDURE

In order to compile such information fifty questionnaires were sent to Kansas vocational agriculture teachers. In this way information was obtained from teachers working under practically all conditions and environments found in the state. Twenty-eight questionnaires were returned and almost all were very useful in this study.

To make this questionnaire such that it would be easily and quickly answered it was put into chart or tabulated form. The information asked for was so arranged that ways to teach the skills or operations and plans for checking results could be ranked according to the teachers' own ideas. Only a very little actual writing, on the part of each

teacher, was necessary in order to satisfactorily return the questionnaire.

The first column was used for a list of tool skills or operations usually taught in Farm Woodwork and for a list of projects in Farm Carpentry (See p. 11). In the second column were placed the educational values to be derived through these tool skills or operations and farm carpentry projects. These educational values were given so that those who answered the questionnaire would be directed along the right line of thinking before they gave their rankings in the next two columns.

The thirty-two skills or operations and farm carpentry projects, listed in column one, were divided into two general sections. The first seventeen tool skills or operations were more elementary and less difficult and were headed as Fundamental Tool Skills or Operations in Farm Woodwork. The remaining fifteen projects were placed under the heading of Farm Carpentry. In the first division the tool skills or operations and in the second division, farm carpentry projects were listed in order of difficulty or amount of skill required. As the student advances the skills acquired lead to more difficult ones. When the student has completed all of the skills or operations and farm carpentry projects, he

should have developed a fair amount of skill and acquired considerable information about Farm Woodwork and Farm Carpentry. The Farm Woodwork and Farm Carpentry taught in Smith-Hughes vocational agriculture are not designed to make skilled workmen, but to make it possible for the farm boy to do such work on his own farm in an acceptable manner.

The third column was used to get information on teaching methods. At the head of this column were placed five satisfactory ways to teach the tool skills or operations and farm carpentry projects listed in column one. Each was given a letter designation, A, B, C, D, and E. Each teacher was asked to rank these five satisfactory ways to teach each tool skill or operation and each farm carpentry project according to his idea of their importance. This was done by merely placing the letter designating each method opposite the number indicating the rank in which he wished to place that particular method.

The five satisfactory ways to teach the tool skills or operations and farm carpentry projects are as follows:

A. Exercise method, product not useful.

B. Making a small usable project.

C. Work on a larger project.

D. Demonstration, explanation, use of charts.

E. Reference to be studied ahead of time.

The exercise method, product not useful, is desirable in teaching some skills that are hard to teach through a large project involving many skills. The term exercise refers to some shop practicum that each boy in the class is required to do. The exercise has little or no usable value after it is finished and has been set up to teach a particular skill or operation or particular farm carpentry project which the student must master before entering into productive activity. If it has value or is useful when finished, it becomes a small project and would come under the second way to teach tool skills or operations and farm carpentry projects, making a small usable project.

Many skills can be taught through the second, making a small usable project. This provides an incentive for the boy to strive for a better class of workmanship because the finished job may be used for something. The acquiring of skills becomes a by-product of doing the job well. This method has the advantage of requiring less expense for material and oftentimes equipment than in the case of large projects.

The third method, work on a larger project, has the same advantages possessed by the second except that more expense for material and equipment is required. In many

cases these advantages are increased. Many times the small projects do not have the respect of the student that larger projects have. The larger projects often require more than one student to build them. Thus, many skills can be taught through a few large projects to a number of students and many times to every member of the class--sometimes even to every boy in the department. Larger projects quite often teach some skills that can be taught in no other way.

The fourth method, demonstration, explanation, use of charts, is a fine method to be used to start the class out on tool skills or operations and farm carpentry projects. It should be used to prepare the class for the tool skill or operation or carpentry project and not be the only method used. It is economical of the teachers' time and quite often of materials. It need be used but once for a class or at most only a few times for the same class.

The fifth, references to be studied ahead of time, is quite similar to the fourth in that it prepares the student for tool skill or operation and carpentry projects to follow and is economical of teachers' time and materials. It teaches the student self-help and to think for himself. Various steps or bits of information which are not clear to the student may be reviewed many times by the student. He

finds the same reference presented in the same way and, by review after part of the project is completed, can continue with the work without much help from the teacher. The teacher can, by reviewing or going over a reference with the student, aid him much more easily than to review a demonstration or explanation.

The fourth column was used to secure information about the best plan for checking results secured. Five plans were listed at the heading of the column and each teacher was asked to rank them as to their importance in checking results of each tool skill or operation and carpentry projects in the same manner as in column three. The plans for checking results are as follows:

A. Observation and grading of work.

B. Small exercise as a test.

C. Informational test.

D. Application to home project work.

E. Application to other project work later on.

Plan A, observation and grading of work, requires the placing of a grade on each tool skill or operation and carpentry project by whatever plan is followed in that particular school. It is a grade based on how well the tool skill or operation and carpentry project is learned and is based

largely on results. However, part of the grade would be determined by how well the student carries out instructions.

Plan B, small exercise as a test, requires the student to make a certain practicum to find out if the skill has been acquired and the information needed to do the tool skill or operation and carpentry project job has been assimilated. It should be given some time after the tool skill or operation or carpentry project has been completed.

Plan C, informational test, is a written or oral test designed to check up on the student to find out how much is known about the tool skill or operation and farm carpentry project.

Plan D, application to home project work, has the idea of checking on the student to find out how well he is applying to his home project what he has learned in the shop. It has a limited use as much of the shop work cannot be used in connection with many home projects.

Plan E, application to other project work later on, is similar to Plan D but has a wider application. The grade is to be based on how well the student applies to other projects what was learned in Farm Woodwork and Farm Carpentry. It has a limited application because much of the work which a student will do later on comes after he leaves school.

The fifth column was used to secure opinions concerning the teaching of related information. Sufficient space was given in the questionnaire for each teacher to write in the related information which is taught in connection with each tool skill or operation and each farm carpentry project. The related information is to be thought of as such information which is not necessary to perform the tool skills or operations in an acceptable manner or to turn out a good farm carpentry project, but is such information that will make for a better workman, a more contented workman, and a more desirable citizen.

Each of the two general divisions of this study, Farm Woodwork and Farm Carpentry, has been divided into two groups so that a more detailed study could be made. The first eleven tool skills or operations in Farm Woodwork were grouped together because they are somewhat less difficult or more elementary than the next six tool skills or operations. In the same way the farm carpentry projects have been grouped. The first seven of these projects are less difficult and require less managerial skill than the last eight projects. From this arrangement it may be determined whether the difficultness of the previously acquired skills or operations and farm carpentry projects have any effect on

the methods chosen by teachers as most practical and satisfactory for advancing the students to new work.

The following is a copy of the questionnaire headings and educational values as listed in the questionnaire. The rankings given under columns three and four are the compiled rankings of those teachers filling in the questionnaires. The related information given in the returns has been summarized and placed in column five of the questionnaire in order of its frequency of listing.

(1)	(2)	(3)	(4)	(5)
Name of Tool Skill or Operation	Educational Values to be Taught	Satisfactory Ways to Teach Tool Skills or Operations	Best Plan for Checking Results	Teaching Related Information
		A. Exercise Method, Product not Useful. B. Making a Small Usable Project. C. Work on a Larger Project. D. Demonstration, Explanation, Use of Charts. E. Reference to be Studied Ahead of Time.	A. Observation and Grading of Work. B. Small Exercise as a Test. C. Informational Test. D. Application to Home Project Work. E. Application to Other Project Work Later on.	Each teacher is to write here the related information which is taught in connection with each tool skill or operation and with each farm carpentry project.

Farm Woodwork - Group I.
(Less Complex Fundamental Tool Skills or Operations)

(1)	(2)	(3)	(4)	(5)
I. Assembling and adjusting a plane	1. To put plane together. 2. To set blade for correct operation. 3. Teach more important parts.	1-D 2-A 3-E 4-B 5-C	1-A 2-C 3-E 4-B 5-D	1. Explain to boys: a. Kinds of steel used in plane. b. Principle of wedge used in plane. c. Why more jack planes are used in shop than other types.
II. Planing	1. To adjust plane to cut uniformly. 2. To learn proper way to hold plane. 3. To gain skill in use of plane. 4. To learn purpose of capiron. 5. How to return plane down when not in use.	1-D 2-A 3-B 4-C 5-E	1-A 2-B 3-E 4-C 5-D	1. Assign questions to be looked up: a. How to prevent splitting at corners when planing across grain. b. Purpose of common types of planes. 2. Teacher give some history of plane.
III. Squaring	1. To place square on board to mark. 2. To mark correctly with square. 3. How to use square in testing.	1-D 2-A 3-B 4-C 5-E	1-A 2-B 3-E 4-C 5-D	1. How to test square for trueness. 2. How to true up a framing square. 3. Into what parts are inches divided on framing square. 4. Teacher demonstrate "6-8-10 Method" for testing squares.

IV. Gauging	1. To learn purpose of gauge. 2. To set gauge. 3. To make cut evenly. 4. To recognize a good gauge line.	1-D 2-A 3-B 4-C 5-E	1-A 2-B 3-E 4-D 5-C	1. Other methods of gauging--caliper, straight edge, rule, and thumb. 2. Other types of gauges: a. Mortise gauge. b. Calipers. c. Rolling gauge. 3. To check for accuracy. 4. To sharpen gauge points. 5. Materials used in making gauges.
V. Sawing	1. How cross cut and rip cut saws operate. 2. To hold and push saw. 3. To start saw. 4. Purpose of set in saw teeth. 5. To finish cut.	1-D 2-B 3-A 4-C 5-E	1-A 2-B 3-E 4-D 5-C	1. Description of saws: a. Size. b. Size of teeth and effect on work. c. Types. d. Materials used in handles. 2. History of saw. 3. How to care for saws: a. How to hang up. b. How saws are damaged. 4. Makes of good saws. 5. Manufacturing processes.
VI. Measuring with carpenter's rule	1. To know common divisions of inch. 2. To place and hold rule while measuring.	1-D 2-B 3-A 4-C	1-A 2-B 3-C 4-D	1. Standards of measure: a. United States official standards. b. Metric.

VI. (con't.)	3. To lay out accurate measurements. 4. To place rule to divide crosswise.	5-E	5-E	2. Materials used in making rules: a. Woods. b. Metals. 3. Types of measuring devices: a. Calipers, inside and outside. b. Verniers and micrometers. 4. Graduations found on carpenter's rule: a. Why carpenter's rules are graduated in 16ths. b. Use for one-tenth graduations. 5. Care of rule.
VII. Laying out stock for simple project in wood	1. To read drawing or blueprint. 2. To determine requirements and select materials. 3. To visualize finished parts to be made from rough materials. 4. To arrange to get most out of rough stock. 5. To mark with pencil or knife.	1-D 2-A 3-B 4-C 5-E	1-A 2-B 3-C 4-E 5-D	1. Woods and their suitability to various uses: a. Grades. b. Strengths. 2. Rudiments of mechanical drawing: a. Isometric and perspective. b. Simple sketching. 3. Types of lumber: a. Shiplap, boxing, carsiding, etc. b. Mill sizes. c. Grades of lumber. 4. Accounting for waste: a. In mill. b. In shop.
VIII. Boring with auger bits	1. To determine size of bits. 2. To know parts of auger bits.	1-D 2-A 3-B 4-C	1-A 2-B 3-C 4-E	1. Care of auger bits: a. Oiling. b. Removing rust. c. Straightening.

VIII. (con't.)				
	3. To learn purpose of each part.	5-E	5-D	2. Makes of good bits. 3. Manufacture of bits: a. Materials used. b. How formed, etc. 4. Kinds of bits: a. Auger. b. Wood twist drill. c. Gimlet. d. Carbon twist drill. 5. Differences in screw threads or feed of bits.
	4. To insert bit in brace.			
	5. To prevent splitting on back side of board as bit finishes hole.			
	6. To guide bits while boring.			
IX. Nailing	1. To learn common types of nails.	1-D	1-A	1. Manufacture of nails.
	2. To start nails.	2-B	2-B	2. History of nails.
	3. Kind of hammer to use.	3-C	3-E	3. Types of hammers to use: a. Hammer faces. b. Shape of hammer heads. 4. Other wood fasteners. 5. Estimating quantities of nails required: a. Number of nails per pound.
	4. To locate nails for holding.	4-A	4-D	
	5. How a nail holds.	5-E	5-C	
	6. To clinch nails.			
	7. Use of nail set.			
	8. To hold nail hammer.			
	9. To prevent splitting of lumber.			
	10. To pull nails.			
	11. To drive nails in hard lumber.			
X. Smoothing	1. Purpose of smoothing.	1-D	1-A	1. Manufacture of sandpaper and emery cloth: a. Kinds of abrasives. b. Wet or dry sandpaper.
	2. To use scraper.	2-B	2-B	
	3. To use spokeshave.	3-A	3-E	
	4. When to use sandpaper.	4-E	4-C	

X. (con't.)				
	5. To sandpaper. 6. Grade of sandpaper to use.	5-C	5-D	2. Tools adapted to smoothing and their use: a. Scrapers. b. Spokeshave. c. Drawknife. d. Rasp. e. Cabinet file. 3. How to sharpen smoothing tools. 4. Adaptability of various woods to smoothing. 5. Beauty of highly finished job after smoothing.
XI.				
Chisel-ing	1. To select chisel. 2. To work to a line. 3. To chisel or pare with grain and across grain. 4. To chisel through a piece. 5. Use of mallet. 6. How to hold for various jobs. 7. When and when not to use chisel.	1-D 2-B 3-A 4-D 5-E	1-A 2-B 3-E 4-D 5-C	1. Manufacture of wood chisel: a. Socket firmer {cabinet / mortise} beveled and square edges. b. Tang type. c. Materials used. d. Brands of satisfactory wood chisels. e. Temper of wood chisels. 2. History of wood chisel. 3. Care of wood chisels: a. To prevent damage to cutting edge and handles. b. To prevent injury to user and others.

(More Complex Fundamental Tool Skills or Operations)

XII. Setting screws	1. To learn common kinds of screws. 2. How a screw holds. 3. To determine size of hole for shank. 4. To determine size of hole for threads. 5. To countersink screw heads. 6. To select proper screw driver.	1-D 2-B 3-E 4-A 5-C	1-A 2-B 3-E 4-C 5-D	1. How screw sizes and lengths are determined: a. Comparison to drill bit sizes. 2. Manufacture of screws: a. Types and kinds of screws and their uses. b. Materials used in screws. c. How usually sold. 3. Proper shape of screw driver bit to use: a. How to sharpen screw driver. 4. Principle of wedge used in screw. Principle of inclined plane used in screw. 5. Lubricants to use in setting screws: a. Soap. b. Cup grease. c. Wax. 6. How to reset old screws. 7. Comparison of holding power of nails and screws. 8. Use of screws made of wood.
XIII. Beveling and chamfering	1. Difference between beveling and chamfering. 2. To mark off chamfer. 3. To mark off bevel. 4. To set the T-bevel.	1-D 2-B 3-A 4-C 5-E	1-A 2-B 3-E 4-D 5-C	1. Purpose of beveling and chamfering: a. Decorative. b. Special shapes. c. To prevent corners and edges from splitting and wearing off.

XIII. (con't.)	5. Use of edge tools in making both. 6. To bevel and chamfer across grain of wood.			2. Use of protractor in determining bevel and chamfer. 3. Use of plane guide in beveling and chamfering.
XIV. Making a half-lap joint	1. That a half-lap joint is and its use. 2. To mark out. 3. To make shoulder cuts. 4. To take out surplus wood between side cuts 5. To fasten half-lap joints.	1-D 2-B 3-A 4-C 5-E	1-A 2-B 3-E 4-D 5-C	1. Other joints, their uses and strengths. 2. Farm jobs using half-lap joints. 3. Advantages of half-lap joint: a. Relative strength. 4. Half-lap joint as applied to ship lap.
XV. Sharpening a plane bit and wood chisel	1. Angle to sharpen each. 2. Results of edges that are too thin--too thick. 3. Why turn grind stone towards edge of tool. 4. To joint edge of tool when nicked. 5. To prevent tool from "burning" while grinding. 6. To whet edge of tool. 7. To test edge when finished.	1-D 2-B 3-A 4-E 5-C	1-A 2-B 3-C 4-D 5-E	1. Grinders to use: a. Proper speed for best results. b. Diameter and width of grinding wheel. c. Texture of stone to use. d. Direction of rotation to reduce and prevent formation of wire edge. e. Mechanical holders to use. f. How to keep face of stone true to shape. 2. Purpose of lubricant in whetting tool. 3. Texture of whet stone. 4. Value of concave bevel. 5. Why use a sharp edged tool.

XVI. Fitting handles to axes, hammers, etc.	1. How to remove handles from eyes of tools. 2. Why the "adze eye" shape of eye of tool. 3. To shape handle to fit into eye. 4. To prepare end of handle for wedges. 5. To treat head end of handle to prevent drying. 6. To prepare wedges. 7. To drive wedges. 8. To finish after wedging. 9. To "hang" handle to lighten work.	1-D 2-B 3-E 4-C 5-A	1-A 2-B 3-D 4-C 5-E	1. Woods suitable for handles and their relative values: a. Age of trees which provide most suitable wood. b. Curing or seasoning wood for handles. 2. Selection of handles: a. Checking grain of wood in handles. 3. Manufacture of handles. 4. Value of purchased wedges.
XVII. Leveling	1. To place level on work to be leveled. 2. To read level. 3. To check level. 4. To level long irregular or uneven surfaces.	1-D 2-A 3-B 4-C 5-E	1-A 2-B 3-C 4-D 5-E	1. Materials used in construction of level: a. Wood requirements. b. Metal requirements. c. Liquid used in glass tube. 2. Types of levels. 3. How to use plumb level. 4. Why level should not be used on bench jobs. 5. To adjust and repair levels.

Farm Carpentry - Group II.
(Elementary Carpentry Projects)

(1)	(2)	(3)	(4)	(5)
Name of Project				
XVIII. Figuring bill of materials	1. To make out material lists. 2. To figure board measure. 3. To figure cost of project 4. To figure cost of waste materials.	1-D 2-A 3-B 4-E 5-C	1-B 2-A 3-C 4-E 5-D	1. Facts to know: a. How to figure waste for flooring, shiplap, car siding, boxing, etc. b. Common lengths and sizes of boards--reasons for undersized material. c. Commercial price quotations. d. Trade terms--quarter and plain sawed, grades of lumber in common use; building hardware quotations--each, dozen, gross. 2. Materials available for certain uses--woods, metals, etc. 3. Relation of board feet to running feet of lumber of common dimensions--linear feet.
XIX. Making singletrees and eveners	1. Determining dimensions of singletrees and eveners. 2. Practice in working to dimensions. 3. Develop skill in planing, chamfering, smoothing, boring.	1-B 2-D 3-C 4-E 5-A	1-A 2-D 3-E 4-B 5-C	1. Choosing suitable woods: a. Strength of woods. b. How to detect flaws in wood. c. Adjust grain of wood for increased strength. 2. Study of hitches--five horse, three rear, and two in lead, and other combinations.

XIX. (con't.)	4. To use drawknife. 5. To develop tapers.			a. Principle of balance for leverage. b. Adjusting hitches or distribution of draft through location of evener holes for various eveners. c. Proper lengths, sizes, and dimensions for various types of work. 3. Types of clips, clevices, etc. to use. 4. What to use in finishing to preserve singletrees and eveners.
XX. Making hog troughs water troughs etc.	1. To teach simple joinery at corners and ends. 2. To teach how and why to slope sides outward. 3. To reinforce end and corners. 4. To waterproof joints with cement, paint, etc.	1-B 2-C 3-D 4-E 5-A	1-A 2-D 3-E 4-C 5-B	1. Capacity of tanks and how to figure them: a. Sizes needed for various conditions. 2. Water proofing substances and how to apply them. 3. Woods to use for troughs and their usefulness: a. Water resisting woods. b. Decay resisting woods. c. Comparative costs and usefulness of other materials. 4. Advantages of various shapes of troughs: a. "V" and flat bottom hog trough. b. Rectangular and round water troughs.

XXI. Making farm gate	1. Dimensions of farm gates: a. Lengths and heights for various uses. b. Spacing boards for various kinds of livestock uses. 2. To brace to prevent sagging. 3. To place hinges. 4. To hang to cause gate to lift at outer end when opening. 5. To prevent decay.	1-C 2-E 3-B 4-D 5-A	1-A 2-D 3-E 4-C 5-B	1. Posts for gates: a. Selection of posts. b. Woods suitable for gate posts. c. Anchoring and bracing posts. 2. Principle of truss construction in nonsag gates. 3. Materials for farm gates: a. Weather resistant woods. b. Angle iron for cross cleats and braces. 4. Types of gates for farm use: a. Wooden. b. Metal. c. Comparative costs of home made and manufactured. 5. Convenience and efficiency of gates.
XXII. Building self-feeders	1. To learn principles of self-feeder. 2. To develop skill in reading blueprint. 3. To develop skill in planning, laying out, sawing, planing, measuring, and boring. 4. To make material lists and figure costs. 5. To figure grain capacity of self-feeders.	1-A 2-C 3-E 4-B 5-D	1-A 2-D 3-E 4-C 5-B	1. Types of self-feeders: a. Advantages and disadvantages of each. b. Advantages and disadvantages of self-feeders over hand feeding--when to use. 2. Capacity of self-feeders: a. Feeding space per head of livestock. b. Proper width and depth of throat for feeds to be fed. 3. How to build: Rain proof, vermin proof, and poultry proof.

XXIII. Making and fitting tongues to farm implements	1. To learn length and dimensions needed. 2. To mark out and make long tapers. 3. To learn the effect of position of wood grain on strength. 4. To gain more skill in planing, chamfering, smoothing, and boring.	1-D 2-E 3-C 4-B 5-A	1-A 2-D 3-E 4-C 5-B	1. Materials used for tongues: a. Home cut and cured wood. 2. How to prevent checking and warping. a. Wood preservation. b. Care of tongue. 3. Strengthening. 4. Prevention of side drafts: a. Proper position of team to tongue. b. Use of trucks on farm implements to save tongues and weight on horses' necks. 5. Usual length from evener to neck yoke.
XXIV. Making wooden parts for farm implements	1. To gain more skill with hand tools. 2. To learn to use less common tools, such as turning saw, circular plane, etc. 3. To learn to make patterns for duplicate parts. 4. To learn to make round parts by use of plane and sandpaper.	1-C 2-D 3-B 4-E 5-A	1-A 2-E 3-D 4-C 5-B	1. Kinds of wood to use: a. Strength. b. Resistance to wear. c. Reinforcing with iron and steel. 2. Preservation and prevention of wear: a. Cause of rotting or decay. 3. Why use wood instead of steel: a. Resistance to shock and sudden stress.

(More Difficult and Managerial Projects)

XXV. Constructing a wagon box	1. To develop more skill in use of common hand woodworking tools. 2. To learn to fasten with rivets, bolts, and screws. 3. To develop appreciation of and need for care in doing high class work.	1-C 2-D 3-E 4-B 5-A	1-A 2-D 3-E 4-C 5-B	1. Materials to use for wagon box: a. Sides. b. Floor. c. Hardware. 2. Figuring capacities in bushels: a. Standard dimensions. 3. Preservation: a. Floor--paint tongue and grooves before nailing to cross pieces. b. Sides--paint. c. Edges--iron to prevent wear on edges of sides. 4. Figuring probable costs. Compare with ready-made box costs. 5. Laying flooring.
XXVI. Planning buildings for livestock. (Base on build-	1. To teach floor planning and arrangement of stalls, pens, bins. 2. To develop size and capacity requirement for livestock. 3. To plan frame work for adequate strength. 4. To learn to brace such buildings. 5. To study types of siding. 6. To study types of floors.	1-E 2-D 3-C 4-B 5-A	1-A 2-C 3-D 4-E 5-B	1. Materials to use. 2. Cost of materials: a. Estimating costs ahead of job. 3. Parts of building: a. Sills, joists, studs, rafters, etc. 4. Frost line for a particular locality and its effect on building foundations.

XXVI. (con't.)	7. To study ventilation systems. 8. To study lighting systems. 9. To learn to make out lists of materials and figure costs.			
XXVII. Choosing and grading building sites	1. To study location of buildings with relation to each other. 2. To study effect of drainage on location of buildings. 3. To study relation of position of building to sun's rays, prevailing winds, etc. 4. Use of surveyors level in locating grading stakes and lines. 5. To grade land to fit needs of buildings for convenience, drainage of water, etc.	1-E 2-D 3-C 4-B 5-A	1-A 2-C 3-D 4-E 5-B	1. Effect of soils, soil texture and underlying rock formation on buildings and their location. 2. Water supply location and its effect on choice of building site. 3. Effect of wind breaks. 4. Trees and shrubs for landscaping.
XXVIII. Laying out foundation	1. To stake out building foundations. 2. To square foundation layout. 3. To use surveyor's level in leveling corner stakes and batter boards.	1-D 2-E 3-C 4-B 5-A	1-A 2-C 3-D 4-B 5-E	1. Locating buildings square with the world. 2. Materials to use. 3. Specifications for foundations for various buildings.

XXVIII. (con't.)	4. To place foundation footings to prevent frost damage.			
XXIX. Building concrete foundation forms	1. To build forms so that they may be removed easily. 2. To prevent spreading. 3. To space forms properly. 4. To use carpenter's level to plumb and level forms. 5. To treat form lumber to prevent concrete form sticking to lumber. 6. Why make waterproof forms. 7. To use foundation lumber after foundation is complete.	1-D 2-E 3-C 4-B 5-A	1-A 2-D 3-C 4-E 5-B	1. To provide for expansion of forms as concrete sets. 2. How to waterproof form lumber. 3. To preserve or prevent decay of form lumber when not in use.
XXX. Framing a small building	1. To develop skill in making material lists and figuring costs. 2. To develop skill in actual carpentry operations. (It is suggested to use hog houses.)	1-D 2-E 3-B 4-C 5-A	1-A 2-C 3-D 4-E 5-B	1. Kinds of framing. a. Strength of materials. 2. Bracing through use of triangles. 3. Losses due to poor framing.
XXXI. Cutting rafters and braces	1. To figure rafter lengths by two or more methods: a. Step-off method.	1-D 2-E 3-B 4-C	1-A 2-B 3-C 4-D	1. Kinds of rafters: a. Types of roofs. 2. Mathematics of a right triangle:

XXXI. (con't.)	b. Proportion method. c. Square root method. 2. To learn terms used in rafter framing. 3. To mark rafters properly. 4. To saw rafters accurately. 5. To learn to add tail to rafter. 6. To learn how to allow for ridge board. 7. To learn to mark and cut braces.	5-A	5-E	a. Geometry of similar right triangles. b. Geometry of hip and valley rafters. 3. Pitches for roofs of various types: a. How to figure pitch.
XXXII. Shingling with cedar shingles	1. To learn principles of laying shingles. 2. To learn to lay shingles. 3. To learn principles of figuring roof costs. 4. To figure cedar shingle roof costs.	1-C 2-D 3-E 4-B 5-A	1-A 2-D 3-C 4-E 5-B	1. Preservation of shingles. 2. History of shingles. 3. How shingles are made: a. Grades of shingles. b. Where produced. c. Woods used for shingles. d. Advantage of edge grain and thicker, longer shingles. 4. Relation of lap to pitch of roof. 5. Distance between shingles that are dry and contain little moisture. 6. Relative costs of roofing materials.

FINDINGS

Farm Woodwork

Less Complex Skills. When a study is made of the satisfactory ways to teach the less complex fundamental tool skills or operations in farm woodwork, it is found that the compiled ranking for the group is as follows: D, B, A, C, and E, as indicated in the following table.

Table 1. Summary of Findings on Satisfactory Ways to Teach Less Complex Fundamental Tool Skills or Operations

Rank Number	1 Assembling and adjusting a plane.	2 Planing.	3 Squaring.	4 Gauging.	5 Sawing.	6 Measuring with carpenter's rule.	7 Laying out stock for simple project in wood.	8 Boring with auger bits.	9 Nailing.	10 Smoothing.	11 Chiseling.	Compiled Ranking for Group
1	D	D	D	D	D	D	D	D	D	D	D	D*
2	A	A	A	A	B	B	B	A	B	B	B	B
3	B	B	B	B	A	A	A	B	C	A	A	A
4	C	C	C	C	C	C	C	C	A	E	C	C
5	E	E	E	E	E	E	E	E	E	C	E	E

*The five kinds of method are indicated as follows:
a. Exercise method, product not useful.
b. Making a small usable project.

c. Work on a larger project.
d. Demonstration, explanation, use of charts.
e. Reference to be studied ahead of time.

This ranking of teaching methods indicates that most teachers teach a job by first giving a demonstration and explanation along with charts or drawings or blueprints that may be needed. After the demonstration and explanations, the boys work on a small usable project which directly teaches the various phases of the skills or operations to be taught. The third choice is the use of the exercise, product not useful, but which is of particular teaching value for that skill or operation. Next in rank is the use of the larger project which will supply many chances to teach the same skills or operations. The least used of all five ways to teach the tool skills or operations is the use of references to be studied before the job is taught. This means that references have little value at first in teaching the less complex fundamental tool skills or operations.

The compiled ranking for the group in Table 1 is D, B, A, C, and E, but the ranking for each job is not always the same. In the tool skills, assembling and adjusting a plane, planing, squaring, gauging, and boring with auger bits, the exercise method, product not useful, ranks ahead of small, useful project as a method to use following the demonstration,

explanation, use of charts method. This can be explained in this way. The students are new and unfamiliar with these beginning skills or operations and need some exercise through which to orientate themselves. These exercises have no value other than to give the student a chance to find out how to perform the simpler skills or operations. The student does not master these skills through the exercises but merely gets started. When the student completes the exercises, he has a chance to make a small useful project and later gets a chance to become more proficient in the tool skills or operations by building larger and more difficult projects.

In Table 1, the last two rankings, B and C for the tool skill or operation, assembling and adjusting a plane, were included but the small usable project or work on a larger project are not applicable to teach this tool skill or operation of assembling and adjusting a plane. The skill or operation of assembling or adjusting a plane must be learned by assembling and adjusting a plane and not through the use of a project of some kind although the operation on a project brings it to the attention of the student.

Plans for Checking. When a study is made of the plans for checking results of teaching the less complex tool skills

or operations in Farm Woodwork, it is found that the compiled ranking for the group is as follows: A, B, E, C, and D as shown in the following table.

Table 2. Summary of Findings on Best Plans for Checking Results on Less Complex Tool Skills or Operations

Rank Number	1 Assembling and adjusting a plane.	2 Planing.	3 Squaring.	4 Gauging.	5 Sawing.	6 Measuring with carpenter's rule.	7 Laying out stock for simple project in wood.	8 Boring with auger bits.	9 Nailing.	10 Smoothing.	11 Chiselling.	Compiled Ranking for Group
1	A	A	A	A	A	A	A	A	A	A	A	A*
2	C	B	B	B	B	B	B	B	B	E	B	B
3	E	E	E	E	E	C	C	C	E	B	E	E
4	B	C	C	D	D	D	E	E	D	C	D	C
5	D	D	D	C	C	E	D	D	C	D	C	D

*The five plans for checking results are indicated as follows:

a. Observation and grading of work.
b. Small exercise as a test.
c. Informational test.
d. Application to home project work.
e. Application to other project work later on.

The foregoing ranking indicates that the best plan for checking results or grading is to observe the finished work and place a grade upon it. The next choice is to use a small exercise as a test which means that the students are

asked to perform some small exercise, and from this it can be determined how well the student has mastered the particular tool skill or operation. The third choice is to find out how well the student applies what he has learned to other project work later on. The use of the informational test ranked fourth which indicates that there is little chance to give a quiz based on information acquired. The fifth and last place rank went to the plan, application to home project work which indicates that little chance can be found to grade farm woodwork tool skills or operations by how well the boy carries out his home project.

More Complex Skills. A study of the satisfactory ways to teach the more complex tool skills or operations in Farm Woodwork indicates that the compiled ranking for the group is as follows: D, B, A, E, and C, as shown in Table 3.

Table 3. Summary of Findings on Satisfactory Ways to Teach More Complex Fundamental Tool Skills or Operations

Rank Number	12 Setting screws.	13 Beveling and chamfering.	14 Using a half-lap joint.	15 Sharpening a plane bit and cold chisel.	16 Fitting handles to saws, hammers, etc.	17 Leveling.	Compiled Ranking for Group
1	D	D	D	D	D	D	D
2	B	B	B	B	B	A	B
3	E	A	A	A	E	B	A
4	A	C	C	E	C	C	E
5	C	E	E	C	A	E	C

*The five kinds of method are indicated as follows:
a. Exercise method, product not useful.
b. Making a small usable project.
c. Work on a larger project.
d. Demonstration, explanation, use of charts.
e. Reference to be studied ahead of time.

The ranking of teaching methods indicates that most teachers teach the more complex tool skills or operations by first giving a demonstration and explanation along with the use of charts, drawings, or blueprints that may be required. When the demonstration and explanations are completed, the boys are put to work on a small usable project which should directly teach the tool skills or operations. If it is not

desirable to use a small usable project, an exercise method, product not useful, would receive next choice to teach the tool skills or operations. The method, reference to be studied ahead of time, is fourth choice to teach the more complex tool skills or operations. Work on a larger project, in the judgement of the teachers, was of little value as it ranked last. This, in the writer's opinion, is due to the difficulty of finding and the expense of using large projects to teach such tool skills or operations.

The compiled rankings for teaching the less complex tool skills or operations listed in Table 1 are the same as for the more complex tool skills or operations in Table 3 except for the last two. In Table 1 the method, work on a larger project, ranked ahead of the method, reference to be studied ahead of time. In teaching the more complex tool skills or operations, the reference to be studied ahead of time was ranked ahead of work on a larger project. This, in the opinion of the writer, is because the students are learning to depend upon themselves more and are ready to do a little reference reading in books or bulletins for themselves before the tool skill or operation is taken up in the shop.

Plans for Checking. A study of the best plans for checking results of teaching the more complex tool skills or

operations in Farm Woodwork indicates that the compiled ranking for the group is as follows: A, B, C, D, and E, as shown in the following table.

Table 4. Summary of Findings on Best Plans for Checking Results on More Complex Tool Skills or Operations

Rank Number	12. Setting screws.	13. Beveling and chamfering.	14. Making a half-lap joint.	15. Sharpening a plane bit and wood chisel.	16. Fitting handles to axes, hammers, etc.	17. Leveling.	Compiled Ranking for Group
1	A	A	A	A	A	A	A
2	B	B	B	B	B	B	B
3	E	E	E	C	D	C	C
4	C	D	D	D	C	D	C
5	D	C	C	E	E	E	E

*The five plans for checking results are indicated as follows:
a. Observation and grading of work.
b. Small exercise as a test.
c. Informational test.
d. Application to some project work.
e. Application to other project work later on.

The above listing indicates that the best plan for checking the results of teaching the more complex tool skills or operations is the same as for teaching the less complex tool skills or operations namely, observation and grading of

the work. The second plan is to use a small exercise as a test. The informational test, application to home project work, and application to other project work later on were tied for third, fourth, and fifth places. This, in the opinion of the writer, means that for more complex tool skills or operations there is little difference in the value of the three plans for checking results. Each seem to have about the same value in grading, or no decided preference was expressed in the rankings given in the questionnaires returned to the writer.

Farm Carpentry

Elementary Projects. A study of the satisfactory ways to teach the elementary carpentry jobs shows that the compiled ranking for the group is as follows: C, D, B, E, and A, as shown in Table 5.

Table 5. Summary of Findings on Satisfactory Ways to Teach Elementary Carpentry Projects

Rank Number	18 Figuring a bill of materials.	19 Making singletrees and eveners.	20 Making hog troughs, etc.	21 Making farm gates.	22 Building self-feeders.	23 Making and fitting tongues.	24 Making wooden parts for farm implements.	Compiled Ranking for Group
1	D	B	B	C	A	D	C	C*
2	A	D	C	E	C	E	D	D
3	B	C	D	B	E	C	B	B
4	E	E	E	D	B	B	E	E
5	C	A	A	A	D	D	A	A

*The five kinds of method are indicated as follows:
a. Exercise method, product not useful.
b. Making a small usable project.
c. Work on a larger project.
d. Demonstration, explanation, use of charts.
e. Reference to be studied ahead of time.

Work on a larger project is first in importance and the demonstration, explanation, use of charts is second in importance in teaching the elementary carpentry projects. This would mean that boys who are beginning to build the elementary projects in carpentry do not need as much help and may be allowed to go ahead with these projects without so much help from demonstration and explanations given by the

teacher. The skill and training gained from learning the woodwork skills or operations enables the boys to depend upon themselves more and less upon the teacher. The third choice was given to the method, making a small usable project. The method, reference to be studied ahead of time, was ranked fourth and the method, exercise, product not useful was ranked fifth. The fifth place ranking for the exercise would indicate that it has little or no use in teaching elementary carpentry projects.

Further study of Table 5 seems to indicate that the teachers filling in the questionnaire are not agreed as to methods of teaching the elementary farm carpentry projects. The method, work on a larger project, was most preferred by those answering the questionnaire but the individual project rankings indicate that it was first in the two projects, making farm gates and making wooden parts for farm implements. The demonstration, explanation, use of charts method, while second choice, was second in only two projects, making singletrees and eveners and making wooden parts for farm implements.

The making of a small usable project was chosen for third place and so ranked in three projects, figuring bill of materials, making farm gates, and making wooden parts for

farm implements. Reference to be studied ahead of time was placed in fourth rank in four projects, figuring bill of materials, making singletrees and eveners, making hog troughs, etc., and making wooden parts for farm implements. The use of the exercise was, according to the teachers ranking these teaching methods, most often placed in last place which shows that it has very little teaching value in the elementary carpentry projects. This lack of agreement as to teaching methods for the elementary carpentry projects, in the writer's opinion, is because the students are not advanced quite far enough to go ahead without much help and guidance, and because the projects are rather elementary carpentry projects and do not fit into teaching methods indicated in the group ranking.

Plans for Checking. A study of the best plan for checking results of teaching the elementary carpentry projects reveals that the compiled ranking for the group is as follows: A, D, E, C, and B, as shown in Table 6.

Table 6. Summary of Findings on Best Plans for Checking Results on Elementary Carpentry Projects

Rank Number	18 Figuring a bill of materials.	19 Making singletrees and eveners.	20 Making hog troughs, etc.	21 Making farm gates.	22 Building self-feeders.	23 Making and fitting tongues.	24 Making wooden parts for farm implements.	Compiled Ranking for Group
1	B	A	A	A	A	A	A	As
2	A	D	D	D	D	D	E	D
3	C	E	E	E	E	E	D	E
4	E	B	C	C	C	C	C	C
5	D	C	B	B	B	B	B	B

*The five plans for checking results are indicated as follows:

a. Observation and grading of work.
b. Small exercise as a test.
c. Informational test.
d. Application to home project work.
e. Application to other project work later on.

The foregoing listing indicates that preference is given to the method, observation and grading of the work. Application to home project work was given second choice, and application to other project work later on received third rank. This seems to indicate that teachers not only observe the work and grade it when finished but watch to see

whether the boy applies what he should have learned from previous shop experience. The informational test was ranked fourth and the small exercise as a test was ranked fifth.

More Difficult and Managerial Projects. A study of the satisfactory ways to teach the more difficult and managerial carpentry projects indicates the compiled ranking for the group as follows: D, E, C, B, and A, as shown in the following table.

Table 7. Summary of Findings on Satisfactory Ways to Teach More Difficult and Managerial Carpentry Projects

Rank Number	25 Constructing a wagon box.	26 Planning buildings for livestock.	27 Choosing and grading building sites.	28 Laying out foundations.	29 Building concrete foundation forms.	30 Framing a small building.	31 Cutting rafters and braces.	32 Shingling with cedar shingles.	Compiled Ranking for Group
1	C	E	E	D	D	D	D	C	D*
2	D	D	D	E	E	E	E	D	E
3	E	C	C	C	C	B	B	E	C
4	B	B	B	B	B	C	C	B	B
5	A	A	A	A	A	A	A	A	A

*The five kinds of method are indicated as follows:
a. Exercise method, product not useful.
b. Making a small usable project.
c. Work on a larger project.
d. Demonstration, explanation, use of charts.
e. Reference to be studied ahead of time.

As indicated in the foregoing table the demonstration, explanation, and use of charts is first choice in teaching the more difficult and managerial farm carpentry projects. Following this, or in connection with it, the reference to be studied ahead of time is given second choice rank. It is evident that the boys are expected to do more studying for themselves so that they will be more independent of the teacher. After the demonstrations and explanations and the reference study, the third place rank was given to the work on a larger project. In this way the boys have a chance to put into use what has been pointed out in the demonstration and explanation or learned from the reference study. The fourth place rank went to making a small usable project. The fifth place rank was given to the exercise method, product not useful. The placing of the small usable project in fourth place and exercise method in the last place indicates to the writer that the more difficult and managerial farm carpentry projects must be taught through the use of life size projects that command the respect of the students and parents.

Plans for Checking. A study of the best plans for checking or grading results of teaching the more difficult and managerial farm carpentry projects reveals that the

compiled ranking for the group is as follows: A, C, D, E, and B, as shown in the following table.

Table 8. Summary of Findings on Best Plans for Checking Results on More Difficult and Managerial Carpentry Projects

Rank Number	25 Constructing a wagon box.	26 Planning buildings for livestock.	27 Choosing and grading building sites.	28 Laying out foundations.	29 Building concrete foundation forms.	30 Framing a small building.	31 Cutting rafters and braces.	32 Shingling with cedar shingles.	Compiled Ranking for Group
1	A	A	A	A	A	A	A	A	A*
2	D	C	C	C	D	C	B	D	C
3	E	D	D	D	C	D	C	C	D
4	C	E	E	B	E	E	D	E	E
5	B	B	B	E	B	B	E	B	B

*The five plans for checking results are indicated as follows:
a. Observation and grading of work.
b. Small exercise as a test.
c. Informational test.
d. Application to home project work.
e. Application to other project work later on.

The foregoing table points out that observation and grading of the finished work rates first choice and the informational test second choice. Previous to this part of the study, the informational test had not been ranked higher than fourth. In the opinion of the writer, this higher ranking of the informational test on the more difficult and

managerial farm carpentry projects indicates that it has much value as a method of grading after the students have had considerable experience and training.

In Table 7 the compiled ranking for the group indicates that teachers rated the reference study next to the top in teaching the more difficult and managerial carpentry projects. Since the study of references is used as a teaching method, the informational test should be used more often as a grading method. Application to home project work was third and application to other project work later on was fourth. This shows that the teacher's observation of how well the student puts into practice what he learns is a method of arriving at a grade which is quite useful. The small exercise as a test is ranked last indicating that it has little use in teaching the more difficult and managerial farm carpentry projects.

METHODS OF TEACHING

Summary

1. The exercise method, product not useful, is used most often in teaching the fundamental tool skills, but as a method for teaching the larger projects in farm carpentry

it is either little used or not used at all. In the writer's opinion, its use should be confined to teaching situations which cannot be covered easily by projects.

2. The small usable project was second choice for teaching the fundamental tool skills or operations, but for teaching the elementary carpentry projects it was third and for more difficult and complex carpentry projects it was fourth. This, in the writer's opinion, means that as the size of the project to be taught increases the small project loses its importance as a teaching device.

3. Work on a larger project is most frequently used to teach the carpentry projects but is seldom used to teach the fundamental tool skills or operations of Farm Woodwork. It is a device most nearly paralleling real life situations and will command the student's as well as the parent's respect.

4. The demonstration and explanation supplemented by the use of charts, drawings, or blueprints is listed first by the majority of teachers except in teaching the elementary carpentry projects where a preference was expressed for the use of a larger project. This method is so useful because the teacher presents a great part of what he teaches by this means. Every student in the class gets the same information in the same way and has the same chances to use it. It is

more economical of teachers' time and should prepare the boys for actual productive work.

5. Reference to be studied ahead of time is most frequently used by the teachers to teach the more difficult and managerial projects in Farm Carpentry. Students do not have the training and experience to make satisfactory use of references before this part of the course.

Conclusions

1. The demonstration, explanation, and use of charts is the most preferred method of presenting new skills or new projects in farm shop work. Through it the teacher presents the best that he has and from it the students must get most of their new ideas of new jobs. Following this the boy must have a chance to try out newly acquired information under the teacher's direction.

2. The small exercise serves as a device through which the boy learns the simpler skills but it has no application in teaching the farm carpentry skills.

3. The small project fits into the need for a device to give the boy a chance to learn less complex skills and at the same time build a useful product. However, the small project has no application to more advanced carpentry skills,

and these must be taught by use of larger projects which command the student's as well as the parent's respect.

4. References in the farm shop should be used as one device to teach more advanced and experienced students.

METHODS OF CHECKING

Summary and Conclusions

1. Observation and grading of the work is the most used method of grading farm woodwork skills and farm carpentry projects.

2. The small exercise as a test is second choice by the teachers to grade the tool skills in Farm Woodwork but last for grading farm carpentry projects.

3. The informational test is not much used to grade the farm woodwork tool skills but gets a second choice rank in grading the more difficult and managerial carpentry projects.

4. Application to home project work has little use in grading the farm woodwork skills but is given second rating for grading the elementary carpentry projects and third rating on the more difficult carpentry projects.

5. Application to other project work later on is used

to supplement other methods of grading and in this way aids in verifying grades decided upon by other methods.

RELATED INFORMATION

Summary

The related information taught in connection with Farm Woodwork and Farm Carpentry is a very important part of the course of study. Too often it is neglected or taught in a haphazard way so that little benefit is gotten from it by the students. Related information should be thought of as information which is not necessary to the performance of the farm woodwork tool skills or operations or the farm carpentry projects, but as information which makes for a better and a more contented workman. As an illustration the skill of sharpening a plane bit can be well done without knowing any of the following information, the quality of steel used in the bit or how it is manufactured, or why grinding wheels should turn at a given speed. These bits of information when taught in connection with the skill of sharpening a plane bit are related information but not necessary to good performance.

Much of the related information will of necessity be given to the students by the teacher in a way that will be helpful and useful to them and aid in getting more satisfactory results in the farm shop work. Students of Farm Woodwork and Farm Carpentry cannot be expected to find for themselves much related information in bulletins and textbooks because they lack experience and basic knowledge for such reading. It is the duty of the teacher to supply this related information when the students are ready for it in connection with some new skill or project. As the student becomes more experienced and has learned considerable about farm shop work he can be directed to search out much of the related information for himself. Individuals or groups of students can be assigned to look up references to gather information for reports to the class.

The related information as reported in the questionnaires may be divided into nine groups. These groups are listed according to frequency of listing.

1. Special rules, principles, or applications.
2. Materials, special descriptions, uses, qualities, etc.
3. Special tools and equipment.
4. Manufacturing processes.
5. Mathematical principles.

6. History.

7. Care of tools, proper uses to prevent injury to the user and to others.

8. Drawing and sketching.

9. Reliable brands of tools and reliable manufacturers.

For a given skill or project most of the related information will be confined to a few of these groups, but for the entire list of jobs the above groups provide a wide variety of related information.

1. Special rules, principles, or applications include a rather large amount of related information that can be taught in farm shop work. Such illustrations which come under this heading are the explanation of why it is necessary to add a certain percent when figuring a bill of flooring, or why a lubricant is used on an oil stone when whetting an edged tool, and the principle of balance for leverage in connection with big team hitchers as studied in building four, six, and eight horse eveners. Many of these special rules, principles or applications will be self evident to the brighter pupils, but will not be understood by the slow or backward pupil unless they are explained by the teacher in connection with the shop work.

2. Materials, special descriptions, uses, qualities,

etc. refers to such related information as kinds of metal used in tools or supplies, or strengths of woods and various materials, or the wearing qualities of materials to be used under certain conditions, or the advantages of flat and edge grain flooring, and many others. To many students, one material serves as well as another but when the difference is pointed out it becomes apparent why various jobs require specified materials of one kind or another.

3. Special tools and equipment heads a list of useful related information. A plane guide for use in beveling or chamfering or how to make a satisfactory substitute is an illustration of such tools or equipment. Jigs, gauges, measuring devices, etc., aid the student in getting more desirable work done, but the knowledge of their use is regarded as related information because they are not necessary to good results.

4. Manufacturing processes were mentioned many times as important related information. The treatment of saw tool steel in order to give it uniform temper, or the grinding and polishing of a saw blade, or the dry kiln method for properly seasoning lumber are illustrations of manufacturing processes to be taught when the right situation presents itself.

5. Mathematical principles, if properly understood, become valuable related information for students of Farm Woodwork on Farm Carpentry. As an illustration, the mathematics of a right angle triangle aid in explaining some of the mysteries of cutting rafters and braces. Practical applications of mathematics as taught in other high school courses may aid in keeping many students interested in high school work.

6. History of the development of tools, equipment or the history back of ways to perform various operations while not necessary for doing good work will aid in improving the quality of the Farm Woodwork and Carpentry. The history of planes for example as illustrated by pictures and drawings explains why planes are built as they are today, and may help to illustrate the principle of how a plane operates.

7. Care of tools, proper uses to prevent injury to the user and to others is a type of related information which in the writer's opinion borders on educational values to be taught. However, it was listed several times in the returned questionnaires and is included for that reason. To illustrate such related information the following will suffice, how to prevent dulling saws, chisels, planes, etc., how to prevent rusting of tools, and how to guide a saw in beginning a saw cut so that it will not injure the users thumb. Such

related information should provide for the teacher a chance to put over higher ideals in the use of tools and equipment.

8. Drawing and sketching seems to be in the teachers' estimation worth while related information. Since most small high schools where vocational agriculture is taught do not teach courses in drawing or sketching, the vocational agriculture teacher will have to teach enough to enable his students to read simple drawings or blueprints and to understand simple instructions. Perhaps, enough should be taught to enable students to prepare simple working plans for their own shop projects.

9. Reliable brands of tools and reliable manufacturers were mentioned a few times as worth bringing to the boys' attention. Such information should aid the student in judging the value and quality of tools, or to decide whether a given product or article is likely to be satisfactory. Such information should aid students in the future when selecting tools, equipment, or supplies for their own use.

Conclusions

The fund of possible Related Information at the disposal of the vocational agriculture teacher is unlimited.

It may be developed in great detail or only introduced as the teacher sees fit and time permits. The teacher's problem is not to find enough information to use but to select and direct the use of such information to maintain the keenest interest and increase to the greatest possible extent the workmanship of his boys without taking time from the jobs to be taught. This is in fact a big problem of the vocational agriculture teacher. He must know the individual boy, his particular environment, his general locality, his limitations and aims, and then select and discard from the wealth of teaching material at hand until he fits the boy's training into that boy's physical and mental equipment and helps him to work from that to his greatest and happiest possibilities as an agricultural worker.

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